

Effects of Systemic Diseases on Biological Tooth Movement: A Review

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Abstract

This article discusses diseases correlated to oral tissue, especially, the one under comprehensive orthodontic treatment. In rheumatic fever, the heart is affected by a systemic disease of the connective tissue. Rheumatic fever is a disease of children and young adults due to a poststreptococcal sensitization from group A hemolytic streptococcus. Epilepsy is complex condition characterized by recurrent seizures or disruptions in brain's normal electric activity. Pregnancy, Asthma, Psychological disorders, hypothyroidism, alcohol abuse. Orthodontic Biological Tooth Movement and bone remodeling efficacy are subjected on systemic features like age, metabolic bone diseases, nutritional influence, and use of drugs. Thus, a comprehensive review of the effects of these diseases on orthodontic tooth movement is attempted in this article.

Keywords: Systemic Diseases; Biological Tooth Movement; Orthodontic Tooth Movement

Introduction

Orthodontic tooth movement is essentially a biologic reaction towards a mechanical force. The application of mechanical forces creates pressure and tension zones in the periodontal ligament and its surrounding alveolar bone.

This leads to certain mechanical, chemical, and cellular events, which can lead to movement of teeth, root resorption, or both (depending on the force and its duration of application).

The early phase of orthodontic tooth movement often creates an acute inflammatory response characterized by periodontal vasculature vasodilatation, and mild pain is a common symptom by patients subjected to orthodontic forces.

Some factors such as cyclic adenosine monophosphate (cAMP), calcium ions, collagenase, and prostaglandins (PGs) play differ-

ing roles in mediating tooth movement in response to orthodontic force.

Molecules produced in various diseases, diseased tissues, and nutrients consumed by patients can reach the mechanically stressed (by orthodontics) dental tissues (both hard and soft) through the circulation and interact with local target cells in the dentoalveolus. The summative effect of mechanical forces and one or more of these agents may be inhibitory, additive, or synergistic.

Systemic diseases and their effect on orthodontic treatment Osteoporosis

It is condition resulting in a loss of bone mass and strength, a decrease in bone turnover with increased resorptive activity. Postmenopausal women, but also (rarely) in adult males. The anti-resorptive medications commonly used by osteoporotic patients include bisphosphonates, estrogen and calcitonin.

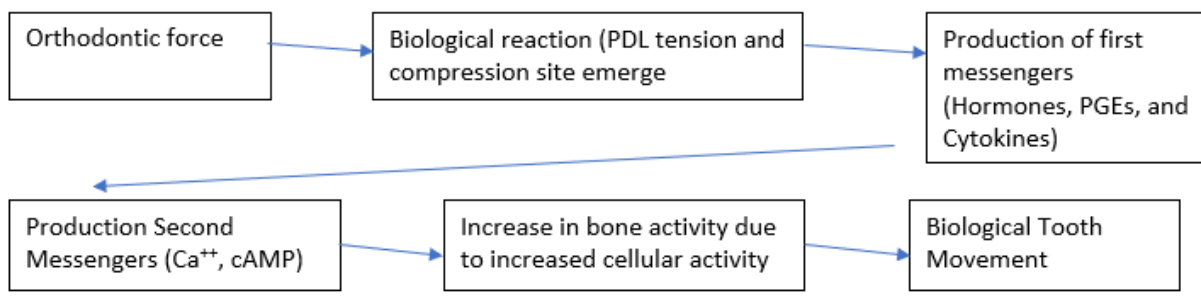


Figure 1

Effect on orthodontics

The apparent mechanism involved consists of significant reductions in the numbers of odontoclasts, osteoclasts, and mononuclear cells on the dental roots, as well as in the alveolar bone, ultimately slowing down the bone remodeling process thereby the pace of tooth movement. Bisphosphonates are taken up into bone, and their effect can last for year.

Figure 2

Rheumatoid arthritis

Characterized by the presence of immune-mediated synovitis (inflammation of synovial membrane in joints) that exhibits the capacity to invade and destroy the extracellular matrices of joint cartilage and bone. Produces cytokines, such as tumor necrosis factor (TNF) alpha and interleukin 1 (IL-1) within the synovial cavity, which trigger production of osteoclasts and can result in irreversible damage to soft tissues and bones. Most of the drugs used for

treatment of rheumatoid arthritis include immunosuppressive agents.

Effect on orthodontics

All these drugs will influence the inflammatory response following force application, reducing the pace of bone remodeling, and thus slow down tooth movement. Rheumatoid arthritis itself will cause bone and periodontal tissue destruction, and thus will accelerate tooth movement. Practitioner should ensure patients who have been diagnosed with rheumatoid arthritis are under control of medication. Orthodontists treating patients with rheumatoid arthritis should be aware of these effects of the drugs and should expect slowed responses to orthodontic forces.

Seizure disorders: Characterized by sudden involuntary alterations in neurologic function resulting from abnormal electrical discharge of cerebral neurons. The treatment of these conditions is directed toward eliminating or reducing the frequency of seizures by using multiple anticonvulsant medications. Currently there are over 20 agents with different mechanisms of action for managing these patients. The drugs, which are important to orthodontic clinicians, are Valproic acid, Phenytoin and Gabapentin.

Effect on orthodontics:

- Valproic acid: Gingival bleeding. (Think banding, isolation).
- Phenytoin: Gingival hyperplasia involvement of the interdental papilla (Think poor oral hygiene with ortho, and possible need for laser resection).
- Gabapentin: Xerostomia (Amazing isolation! But caries...).

Figure 3

Seizures themselves have not been found to have a significant effect on tooth movement. Orthodontists should be aware of, and educate patients and their parents that oral hygiene, especially with medications that these patients will be on will be of utmost importance. Consider taking extra time during case presentation. Educate parents that safety of child during a seizure is of more importance/effect on treatment than any direct effect on tooth movement.

Asthma

Characterized by episodic narrowing of the airways that results in breathing difficulties and wheezing

Effect on orthodontics

High risk: Orthodontic treatment should not be performed in patients who experience very frequent flare-ups despite being adequately medicated. Low to moderate risk: morning appointments with short waiting times are advised.

Long term use of inhalers (corticosteroids) can lead to oral candidiasis and xerostomia, so topical antifungal agents, topical

fluoride application and salivary substitutes have to be performed before and during the orthodontic treatment period. High risk for developing excessive root resorption during the course of orthodontic treatment. Low forces for these patients are strongly recommended.

Psychiatric problems

Attention-deficit/hyperactivity disorders, depression, eating disorders, and anxiety disorders.

Effect on orthodontics

Attention-deficit/hyperactivity disorder (ADHD) patients are treated with Central Nervous System stimulants. These drugs may have immediate impact on orthodontic treatment, related to problems with patient compliance and home care, as well as maintenance of oral hygiene. Not treating these patients with medication can also lead to compliance issues...Elastic wear, headgear, etc. Depressed patients are managed with antidepressants and mood stabilizers. No direct effect on orthodontics and/or tooth movement, but patient motivation and home compliance can be an issue.

Figure 4

Psychological stress affects the hypothalamic–pituitary–adrenal (HPA) axis, and the immune system. As osteoclasts and odontoclasts are derived from the immune system and influenced in terms of activity by various cytokines which can be released in times of stress, modification of their function by psychological stress may impact the process of root resorption. Animals subjected to stress and experimental orthodontic treatment demonstrated reduced amounts of tooth movement when compared with controls and non-stressed orthodontically treated animals. They also showed the greatest amount of root resorption throughout the experimental period.

Hypothyroidism

Hormonal disorder where not enough thyroid hormone is made.

This will lead to decreased bone turnover, generally slowed metabolism, and somewhat decreased speed of tooth movement under orthodontic force. Thyroxin administration (taken by many of these patients) leads to increased bone remodeling, increased bone resorptive activity and reduced bone density.

Effect on orthodontics

The thyroid hormone supplement taken by many of these patients increases the speed of orthodontic tooth movement, but if dosed correctly, will amount to roughly equivalent tooth movement. Immunocompromised patients are Patients with chronic renal failure, transplant patients and those on immunosuppressant drugs.

Immunocompromised patients

Patients with chronic renal failure. Transplant patients and those on immunosuppressant drugs.

Effect on orthodontic treatment

The drug consumed for prevention of graft rejection (Cyclosporin A, for example) produces severe gingival hyperplasia. It is suggested that for the first six months (when gingival hyperplasia is at its peak), orthodontic treatment should be deferred in these patients and resumed once oral hygiene is good and/or gingivectomy has been completed if deemed necessary. Keep use of bands to a minimum, minimize treatment timelines. Invisalign a good option. Use of removable appliances in these patients is not recommended if gingival overgrowth prevents fit of appliances.

Diabetes

Two main types, both of which involve defects in the body's ability to produce or respond to the hormone insulin, resulting in high concentrations of glucose in the bloodstream.

Effect on orthodontics

Morning appointments, ideally right after a meal. Xerostomia a frequent side effect. fluoride. Compromised periodontal health. Careful scrutiny of oral hygiene and periodontium at all visits. Use light orthodontic forces. Patients can have microangiopathy, which can lead to pain, sensitivity, and even loss of vitality. More frequent radiographs. Patients with corticosteroid therapy: The side effects of long-term steroid therapy include disturbances in mineralized tissue metabolism and wound healing, discrepancies in chondrogenesis and osteogenesis, bone loss and osteoporosis.

Patients with corticosteroid therapy

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Effect on orthodontic treatment

Rat studies on acute and chronic corticosteroid treatment revealed that the tooth movement rate increased in the chronic group. Force application resulted in a significant increase in the relative extension of resorption and formation in both groups, indicating that the orthodontic force level should be reduced and controlled more frequently.

Alcohol abuse

Chronic ingestion of large amounts of alcohol on a daily basis may lead to severe complications, such as liver cirrhosis, neuropathies, osteoporosis, and spontaneous bone fractures

Effect on orthodontic treatment

Circulating ethanol inhibits the hydroxylation of vitamin D3 in the liver. increased synthesis of parathyroid hormone. Enhanced resorption of mineralized tissues, including dental roots. High risk of developing severe root resorption during the course of orthodontic treatment.

Pregnancy

Orthodontic treatment not contraindicated. Gingival hyperplasia due to hormonal influences is possible. Oral hygiene concerns. Increased bone turnover. Increased risk of alveolar bone loss and root resorption.

Effect on orthodontic treatment

More frequent radiographs would be indicated, yet, pregnant women should be exposed less to x-rays! Treatment should be deferred until pregnancy is complete, if possible. If patient becomes pregnant during treatment, use clinical judgment. Likely decrease forces as much as possible, short, and morning visits [1-12].

Conclusion

Dentists should acknowledge the crucial features of each systemic disease on the oral tissues, as well as, their drug effects. Having a conspicuous picture will improve the treatment plan, type of treatment, and the duration for any Dental intervention. the type and nature of orthodontist intervention treatment with such patients, add more responsibility and certain degree of importance in dealing with those patients.

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